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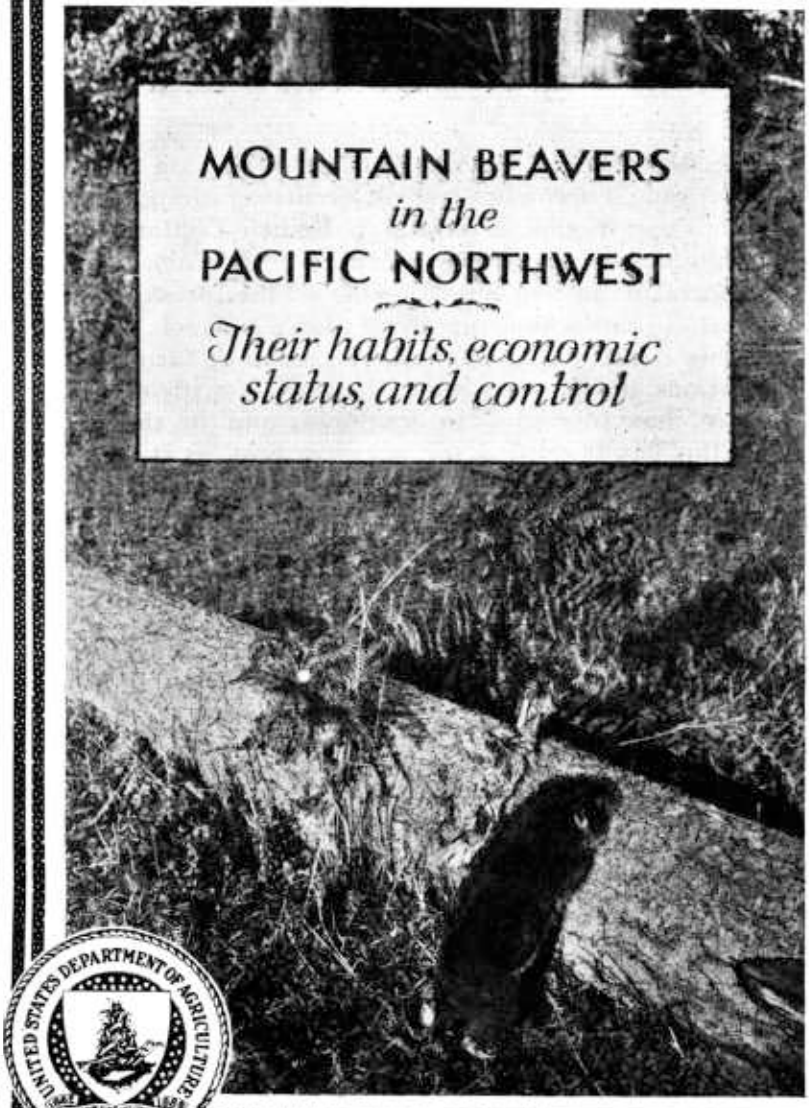

MOUNTAIN BEAVERS *in the* PACIFIC NORTHWEST

Their habits, economic status, and control

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THE MOUNTAIN BEAVER, or sewellel, is a herbivorous, burrowing rodent, occurring along the Pacific coast region of southern British Columbia, Washington, Oregon, and northern California. In its natural haunts in the seclusion of the forest, the animal did not materially affect man's interests, but with his clearing of lands and extension of farming operations it has come more in contact with agriculture, has increased in numbers, and in many localities has become a serious crop pest, as it will eat almost anything the farmer or orchardist can grow.

This bulletin is based on an extensive study of the mountain beaver and gives an account of its life history, describes its feeding habits, and recommends methods for its control where necessary.

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MOUNTAIN BEAVERS IN THE PACIFIC NORTHWEST: THEIR HABITS, ECONOMIC STATUS, AND CONTROL

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INTRODUCTION

WHEN the more accessible coastal areas of the Pacific Northwest had been partly logged off, the ranchers that followed the axmen into the little valleys and over the lower bench lands found there a strange native rodent, which came to be known as the mountain beaver, or sewellel. (Fig. 1.) Though naturally very abundant in many wooded localities up and down the coast, it soon appeared that the little animal was increasing in numbers by reason of the more favorable environmental conditions that followed partial clearings and the spread of farming. At least such conclusions may be drawn from statements of early settlers and from the general complaint in recent years of the increasing depredations of the rodent on crops.

The name "mountain beaver" is generally used to designate members of the genus Aplodontia, although the animal is not a beaver and is more abundant at lower altitudes than in the mountains. In Oregon it is commonly known as "boomer," but it does not boom; and in some districts as "whistler," but it could not whistle if it tried. The term "sewellel" comes to us from the reports of the Lewis and Clark expedition, in which first mention of the animal is made in literature. It appears, however, that this Chinook Indian name was applied, not to the animal itself, but to the robe or blanket made from its skins. In the Nisqually Indian tongue of the Puget Sound country this rodent was called "sh'auch," to designate the character of the mammal's movements. (See p. 3.)

DESCRIPTION AND DISTRIBUTION

The mountain beaver resembles in size and general appearance a tailless muskrat, for instead of having the characteristic appendage

of the true beaver (*Castor canadensis*), the mountain beaver has a tail that is so short as ordinarily to escape notice. The ears, too, are very short, and the small eyes lack the snap and expression noted in rodents living more in the open. The body is stout and compact, the adults averaging slightly more than a foot in length. The average weight of the Olympic type is approximately 2¼ pounds. As its legs are short and its feet plantigrade (as in bears), the mountain beaver seems to creep rather than to run over the ground, but even so it progresses fairly rapidly. As in some other rodents, the front feet are well adapted for grasping, serving thus for holding food and

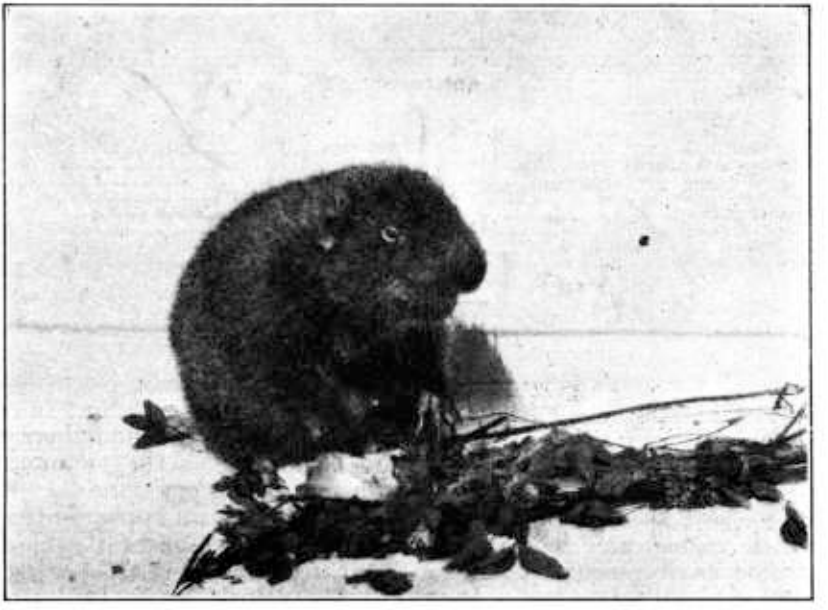

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FIGURE 1.—The mountain beaver, known to science as *Aplodontia rufa*, and variously termed boomer, whistler, or sewellel, inhabits the Pacific Northwest, where in many localities it becomes a serious pest. It is about the size of a muskrat, the various forms varying in dull brownish color tones

climbing small saplings as well as for locomotion. They are also armed with strong claws for digging. (Fig. 2.) Long sensitive hairs, or whiskers, adorn the sides of the face. The pelage is grayish or reddish brown and more or less grizzled above with darker hairs. On the underparts the fur is grayer, as is also the entire coat of the younger animals. There are no strongly contrasting colors, except on the dark circular areas about the mammae of the females in summer pelage.

The mountain beaver lives only in the Pacific coast district of North America. There is only one genus to represent this remarkably conservative group of animals, and not enough variation throughout its range to characterize more than a single species. This species (*Aplodontia rufa*) has been divided into nine subspecies, or

geographic races,[1] and its range is along the Pacific coast from southern British Columbia south to San Francisco Bay and east to the Cascades and Sierra Nevadas. (Fig. 3.)

HABITAT

The mountain beavers of western Washington and Oregon may be found in almost any wooded situation where the soil will permit fairly easy burrowing. They are more numerous, though, on the slopes of the ridges and foothills and along the sides of the many gulches, large and small, that cut through the bench lands. (Fig. 4.) Here amid tree trunks and dense and tangled undergrowth they find shelter and concealment. In these situations food is abundant almost anywhere the year round, and water, if needed, may be reached by short excursions. Though not aquatic in any sense, the mountain beaver is usually found not far from running water. The animal continues to make use of its burrows even when they are partly flooded, and will pad along in shallow streams when it could apparently just as well as follow the shore.

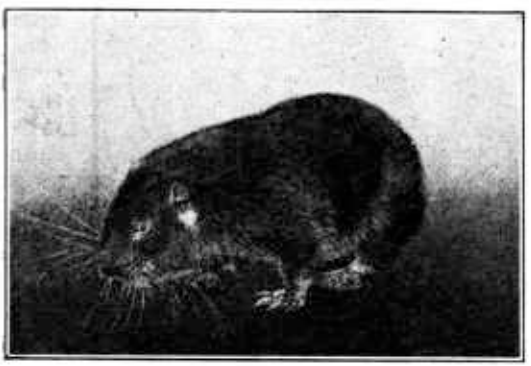

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FIGURE 2.—Armed with strong claws for digging, the mountain beaver burrows under logs and into banks, and it is able to climb saplings, where it cuts tender branches and terminal shoots. It also stores and eats anything cultivated within its range

The deep forest does not harbor nearly so many mountain beavers on a given area as do old burns and cut-over lands, where more food is afforded by second-growth trees and herbaceous vegetation and where more retreats are made available by the débris of the former forest. If there has really been a considerable increase in the numbers of the animal in recent years, as older settlers claim, it has been due to these more favoring food and shelter conditions, as well as to the destruction of its natural enemies by man.

RETREATS AND BURROWS

The Indians of the Puget Sound country call the mountain beaver "sh'aueh," as nearly as the sounds can be represented by written characters, to designate, it is said, an animal that crawls under and through brush and herbage; or perhaps it may refer only to the act of crawling. At any rate, this aptly describes the animal's ordinary progress in getting about. Though it travels from place to place a great deal, usually within short limits, there are no well-beaten trails above ground, such as those made by marmots and burrowing squirrels. Most of the runways are in shallow burrows with many open-

[1] TAYLOR, W. P. REVISION OF THE RODENT GENUS APLODONTIA. Univ. Calif. Publ. Zool. 17: 435–504, illus. 1918.

ings, and some are half-concealed paths among logs, stumps, and brush piles. Its deeper tunnels form an irregular network of highways that can scarcely be the product of any considerable degree of engineering instinct, for the construction is apparently without any general plan. The lay of the rotting log, the slope of the bank, the position of upturned tree roots with their loads of earth—all these and many more local factors determine the direction and extent of the runways and the location of their entrances and exits.

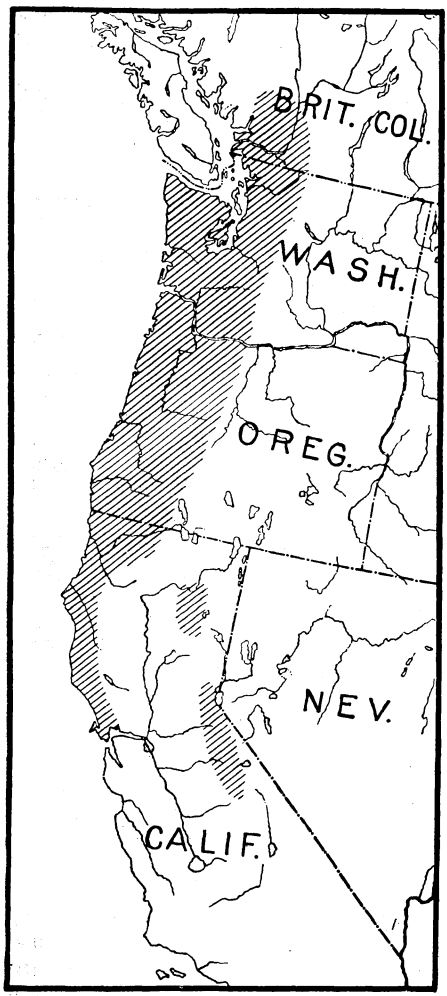

FIGURE 3.—Distribution of mountain beavers (Aplodontia) in North America

On some of the hill slopes of the Olympic Peninsula, in Washington, the extent of the burrowing by mountain beavers is such as fairly to honeycomb the ground. Where the infestation is heavy the openings into their subterranean tunnels will sometimes average as many as 10 or 12 to the square rod. Some of these openings are constructed by the animals themselves, others are the result of erosion and caving; for, while the mountain beaver keeps its tunnels free from obstructions, it does not, like the mole or the pocket gopher, repair breaks in the roof. Ordinarily the natural burrow entrances are concealed by ferns or shrubbery, but the animal shows its readiness to adapt itself to changed conditions by tunneling into the banks at the roadside and under the stumps of the open meadow. (Fig. 5.) Certain openings into the burrows are not used for entrance and exit, but for pushing out excavated earth, spoiled food stores, and other rubbish. These alleyways are always more or less obstructed by such materials.

Connected with the runways proper, which are at least 3 or 4 inches in diameter, are enlargements here and there for nests or temporary food storage. The nests are placed in the hillocks formed by trees uprooted long ago, or under old logs, in shelving banks, or about the bases of stumps. In such situations they are fairly well protected from the prolonged soaking rains that visit the Pacific

Northwest in the winter months. One nest chamber that was excavated and studied measured 17 inches in vertical diameter and had an average horizontal diameter of 18 inches. The corresponding dimensions of another were 19 and 17 inches, respectively. In one case there was only a single approach to the nest. In the other, two tunnels led out from opposite sides, and each soon forked. The nest chambers were less than 2 feet below the surface of the ground and were roofed over by a thin layer of clay that appeared to have been packed. The materials of the nests were leaves, dried ferns and grasses, and some small twigs. Another nest was largely made up of dried pea vines from a neighboring field.

B18709

FIGURE 4.—The burrows of the mountain beaver are most numerous on the slopes of the bench lands and foothills, and along the sides of the many gulches that intersect the glacial moraine of western Washington and Oregon. The runways are partially underground, and some are half-concealed paths among logs, stumps, and brush piles

HABITS AND SENSES

Unless an observer resorts to night prowling he is not likely to encounter a mountain beaver abroad. The little animals certainly travel their secluded paths and burrows at almost any time of day, as the records of the trap show, but they rarely leave them until early in the evening. Then, under cover of darkness, they wander about to some extent in the open, mainly to collect food supplies. In these nocturnal excursions they often enter upon or cross public highways and are killed by passing automobiles, for they are too slow to escape such traffic. Occasionally they are seen on lighted streets of smaller towns, and have even been known to climb over porches and to blunder through open doors. Ranchers on little hillside clearings report seeing them out only rarely in the daytime.

Once the writer, while seated quietly on a stump at the noon hour, had the good fortune to observe a mountain beaver come from its

burrow beneath a log less than a rod away. After reconnoitering a bit the animal paddled up a shallow stream for a short distance and disappeared in some shrubbery, whence it soon reappeared dragging young shoots of the common bracken (*Pteridium aquilinum*) perhaps 2 feet long. Dropping these at the burrow entrance, it again ventured forth in search of food. In all it made seven such foraging trips, passing sometimes within a few feet of the observer without noticing his presence. It then returned to its burrow and began to cut into sections the green shoots it had deposited at the entrance.

B19870

FIGURE 5.—Mountain-beaver burrow in a highway cut. The animal shows its readiness to adapt itself to changed conditions by tunneling into the banks at the roadside and under the stumps of the open meadow

SOCIAL HABITS

There is no evidence that mountain beavers possess any social traits in the strict biological sense. Though they sometimes live together in such numbers that their burrows fairly honeycomb the ground, the activities of the individual seem to concern only itself and are in no way related to the common good. It can not properly be said of them, therefore, that they live in colonies. In the struggle for existence they are merely crowded together sometimes by the necessities of environmental conditions—food, shelter, soil. When kept in captivity they do not huddle together in their common fear and dejection, but appear grouchy, each resenting fiercely the slightest contact with its fellow.

FOOD HABITS

The mountain beaver uses either for food or nesting material almost any green thing that grows in its habitat. By noting critically the signs of its feeding on herbaceous plants and shrubs and by sorting over the food supplies cached temporarily at burrow entrances (fig. 6), one may get first-hand knowledge of the diet—practically everything the season affords. Even the unsavory skunkcabbage (*Lysichiton camtschatcense*) and the prickly devilsclub (*Echinopanax horridum*) are cut or trimmed for food, and when the mountain beaver goes foraging the farmer complains that his onions and rhubarb disappear along with other garden truck.

Herbaceous plants are eaten, stem, leaves, and all; while woody plant structures are discarded after the bark has been peeled off for food. Rejected material consisting of these peeled sticks, together with spoiled food supplies and other refuse, may commonly be noted about the openings from mountain-beaver burrows. The refuse affords evidence that the animals habitually cut and store away more food than they can eat before it spoils. The nature of the food itself, it may be noted, precludes storage in sufficient quantity to tide the animals over periods of prolonged scarcity. (Fig. 7.)

When winter snows lie deep in the lower Cascades and in the Olympics, the mountain beavers resort to feeding on the bark of saplings and even of large trees, both beneath the snow covering and above the crust. This will explain the condition of tree trunks

B16667

FIGURE 6.—Mountain beaver feeding near burrow entrance. The animal cuts and stores more plants, both native and cultivated, than it can use for food and nesting materials before they spoil

that, at the base, appear bare and tooth-scarred when the snows have melted away. (Fig. 8.) It will also account for the girdling of second-growth evergreens at a height, sometimes, of 3 feet or more from the ground. Tall, slender saplings that have been weighted down to earth by wet snow, when freed of this incubus, appear as bare poles.

There is no evidence that mountain beavers can climb trees, either by clinging to the bark or by embracing the trunk. They do, however, readily ascend the taller shrubs and the saplings ordinarily to a height of 8 or 10 and sometimes even 12 or 15 feet, cutting off every branch as they go. (Fig. 9.) This trimming process usually includes also the terminal shoot. Perhaps with design, more likely unwittingly, the little animal makes provision for its ascent and

descent by leaving stubs of the branches to serve as the rounds of its ladder. The commonest sign of the mountain beaver's abundance in any particular locality is the trimmed and pruned appearance of the shrubs, bushes, and vines. (Fig. 10.)

The season when herbaceous food is abundant is also the time when the mountain beaver feeds largely on the cuttings of deciduous trees and shrubs, showing thus that it prefers this class of food. At this season an examination of the green-food supplies cached at burrow entrances reveals little or no evergreen material. On the other hand, winter supplies consist almost wholly of evergreens—salal (*Gaultheria shallon*), Oregon grape (*Berberis nervosa*), ferns, cedar, fir, and hemlock. The neglect of deciduous trees and shrubs

B13713

FIGURE 7.—Temporary cache of food supplies. Ferns and small branches of evergreen trees are among the many kinds of green vegetation dragged to the burrow entrances to be used for food by the mountain beaver

when not in foliage would seem to indicate a preference for the leaves rather than the bark.

The harvested cuttings, whether of herbaceous plants or of woody stems and branches, may vary in length from a few inches to several feet; for the mountain beaver does not usually cut up the larger green pieces until it arrives at its burrow entrance or other safe retreat. Here the material is cut into short sections, if necessary, so that it can be readily carried back into the underground passageways to be eaten or stored. When dragging long shoots on a foraging trip, the animal holds its head more or less to one side to avoid tramping on its load. Shorter pieces are carried in the mouth, with the head well raised.

The butt of a cutting made by the mountain beaver, or the end of the stub from which it came, shows practically always only a single sloping face, as though the work had been done by one stroke

of a sharp instrument. In this respect the mode of operation differs from that of the true beaver (*Castor canadensis*), which gnaws around a stem, its incisions going deeper at each turn and leaving the cut shaped roughly like an hour glass. Of course, animals of the genus Aplodontia do not cut stems exceeding the major fraction of an inch in thickness, while true beavers will fell trees much more than a foot in diameter.

Very commonly little piles of mixed herbs and grasses cut by mountain beavers may be noted in summer lying in exposed places to dry and cure in the sun. This circumstance has given rise to a belief that the little animal is "making hay" to store in its under-

B18700

FIGURE 8.—Both deciduous and evergreen trees, sometimes a foot or more in thickness, are commonly girdled by mountain beavers under the snow, when the animals can not conveniently forage

ground "mows" for future consumption. As there is little really dry material to be had at any season of the year in the mountain beaver's environment, it is more probable that the "hay" is to be used for bedding. Such material is to be found in the nests, which are described elsewhere.

The following is a list of the native food plants found in the cuttings or stores of Aplodontia in the Puget Sound country:

Bracken (*Pteridium aquilinum*).
Fern (Polystichum).
Horsetail (Equisetum).
Cedar (*Thuja plicata*).
Douglas fir (*Pseudotsuga mucronata*).
Western hemlock (*Tsuga heterophylla*).
Skunkcabbage (*Lysichiton camtschatcense*).
False Solomonseal (*Vagnera sessilifolia*).
Willow (Salix).
Hazel (*Corylus californica*).
Alder (Alnus).
Nettle (*Urtica lyalli*).
Fringe cup (Tellima).
Gooseberry (Grossularia).
Currant (Ribes).
Hardhack (Spiraea).
Goatsbeard (*Aruncus aruncus*).
Raspberry (Rubus).
Thimbleberry (*Rubus parviflorus*).

Wild cherry (Prunus).
Clover (Trifolium).
Wild pea (Lathyrus).
Maple (Acer).
Willow-herb (Epilobium).
Devilsclub (*Echinopanax horridum*).
Dogwood (Cornus).
Salal (*Gaultheria shallon*).
Snowberry (Symphoricarpos).
Elder (*Sambucus callicarpa*).
Sow thistle (Sonchus).
Yarrow (*Achillea millefolium*).
Pearl everlasting (*Anaphalis margaritacea*).

Any list of cultivated fruits, berries, vegetables, and grasses eaten by the mountain beaver might include almost everything the farmer or orchardist could grow within the range of the rodent. These matters are discussed under the next heading, "Injurious habits."

B18687

FIGURE 9.—Although mountain beavers can not climb trees, they readily ascend the taller shrubs and saplings and trim off the twigs and terminal shoots for food

INJURIOUS HABITS

Like other burrowing rodents, the mountain beaver becomes a nuisance in settled communities, both by reason of its habit of digging anywhere and everywhere and because of its pillaging in gardens and fields. In the wilds of its native haunts it probably does not affect man's interests one way or the other. In many districts of the coast country, however, the little animal is so abundant as to become a serious pest. Along the edges of the clearings and about stumps, logs, or brush piles left in the fields it finds shelter and from these situations makes its forays on growing crops.

Although the hay rancher sustains some damage in clover and meadow grasses, the gardener and the berry grower have more cause for complaint. Almost anything they try to grow the mountain beaver cuts and carries away to its burrows, and if they are not properly vigilant their truck disappears night after night at a surprisingly rapid rate. Strawberry plants, kale, cabbage, mangel tops, raspberry canes, pea vines, and the like form the bulk of the

plunder. Fortunately, owing to the difficulties of transporting green materials, the mountain beaver does not ordinarily forage far from its retreats.

The valley rancher is particularly annoyed by the mountain beaver's persistent habit of frequenting the blind ditches that drain his lands. Not only does the animal clog them up with refuse, so that the boxing has to be laboriously dug up and cleaned out, but it also uses them as highways to reach the interior of his cultivated fields. Walls of the larger open ditches also are tunneled, so that drainage is obstructed by cave-ins as well as by the heaps of earth that are pushed out.

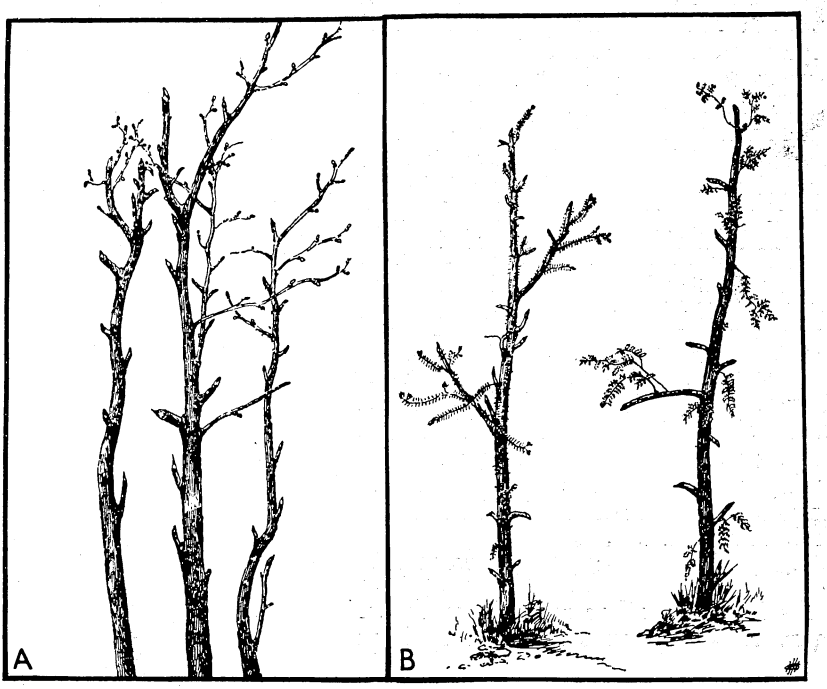

FIGURE 10.—Saplings are trimmed and topped by mountain beavers. Both deciduous (*A*) and evergreen saplings (*B*) are cut in the manner shown, the stubs of the branches serving as the rungs of a ladder to assist the rodents in climbing

Damage to highways by mountain-beaver burrows passing under the roadbed has been reported by engineers, particularly in the Olympic Peninsula. Slides in road cuts due to the activities of this animal also contribute to the troubles of those charged with keeping up the public roads. Farm animals are injured also by their feet breaking through into the burrows that pass from the edge of the woods to stump, log, or brush pile in the open field. The obvious remedy for this trouble is to clear the land thoroughly, so that no such shelters remain to harbor the rodents that dig the tunnels. But removing stumps especially is expensive in the Northwest and must usually await the growing prosperity of the new rancher.

Not the least of the difficulties that beset the life of the rancher of the northwest coast country, and of the city dweller there who seeks

rest and recreation in his rural cabin, is the maintenance of a pure water supply. It is not that water is scarce, but the source of supply is found usually in surface springs in which certain mountain beavers seem to have priority rights. These must be dispossessed and their successors kept away if the human dwellers in the vicinity are to have clear, pure drinking water.

Although damage by mountain beavers to forests in the Northwest is on the whole as yet scarcely appreciable, it must be taken into consideration even now in restricted localities. On certain cut-over or burned-over slopes heavily infested by these animals, reforestation is obviously much retarded because of their depredations. Such injury must be taken more and more into account by those having to do with national reforestation programs. In the little openings or semi-clearings on these tracts hundreds of slender sprouts and saplings may be found that have been trimmed of their side branches and usually also topped. These commonly die or are dwarfed by frequent retrimming. Many of the young trees also suffer, including those up to several inches in diameter. Occasionally from a point of limited view one may note that 40 to 50 per cent of the young tree and shrub growth in sight has been girdled, barked at the roots, or trimmed of side branches and topped. Fir, cedar, hemlock, alder, maple, willow, cherry, shrubby undergrowth—all share the same fate.

Mountain beavers show no haste to abandon the ground they have been occupying when it is being cleared and prepared for agriculture. In spite of the removal of sheltering vegetation, the heavy concussions of blasting, and the burning of log piles and brush heaps, they will stick to what is left of their burrows, opening them up when obstructed and sometimes extending their feeding range. Living under these conditions they are wont to seek the rancher's spring, where they make trouble by roiling the water and plugging up the fountain sources in their efforts to reestablish themselves in their old haunts.

SPECIAL SENSES

As in many other animals of fossorial habits, the sense of sight in mountain beavers is not very keen, and the range of vision is limited. When confined in large inclosures these rodents sometimes approach so close to an observer as to touch him before sensing danger. A quick movement, however, will send them scurrying to safety. The least touch, too, will put them quickly on the defensive. The special tactile hairs, or whiskers, are highly developed, as in the domestic cat. The only evidence at hand as to their sense of smell relates to their choice of food. They readily leave their burrows in the twilight of evening to follow a trail of apple peelings or other tempting bait. Judging from observation of their mode of life, it is probable that the sense of smell plays but little part in enabling them to detect the presence of an enemy. On the other hand, it is no doubt their chief means of recognizing their kind, for they possess an unmistakable body odor, though it is not so pronounced as in the case of the Mustelidae, including martens, weasels, otters, and skunks.

Observation and experiment indicate that mountain beavers hear well, though apparently they have no regular call note. The booming or whistling sounds credited to them by careless observers can be traced to other sources, probably to the sooty grouse (*Dendragapus*

obscurus fuliginosus) in one case and to the marmots of the Cascades and the Olympics in the other. They do, however, give vent to vocal expression of pain and anger. When caught in a steel trap they complain in a whining tone and when fighting among themselves squeal lustily, like so many rats. When annoyed by an observer they also produce an aspirated sound.

WINTERING

With plenty of food usually available the year round, the mountain beavers remain active at all seasons. At least this is true at the lower altitudes at which they are commonly observed. Under a snow covering of a foot or more they will burrow extensively, usually, though not always, working so close to the ground as to leave a trail or path scratched in the soil. Sometimes the snow burrows lead to the surface, especially near logs or stumps, and the animals come out and travel about on the crust. This is indicated by their tracks and by the marks of girdling and gnawing on the bark of shrubs and young trees. They also have been observed wandering about at evening twilight on the snow crust of open fields.

With the gradual melting of the snow, portions of these mountain-beaver burrows are successively exposed, showing their course and extent. Sometimes they run for several rods from one retreat to another. More often, though, the paths on the ground under the snow lead nowhere in particular and appear to indicate bewilderment of the animals under their unusual surroundings. That they are sometimes hard pressed for food on these occasions is indicated by the appearance of their tooth marks on large trees divested of all bark at and near the roots, and by the extensive gnawing on whole clumps of such shrubs as gooseberries.

In the winter season the mountain beaver has to adapt itself to the inconvenience of having parts of its runways flooded by the prolonged rains and sometimes by the run-off from the melting snow. While this run-off is in progress much of the water on certain slopes courses through mountain-beaver tunnels, sometimes leaving the slopes almost free from surface channels. After the water has drained away it has been observed that the animals reoccupy their former burrows and make repairs and extensions as before.

BREEDING

There is no appreciable difference in color or size to aid in distinguishing the sexes in the mountain beaver. The males average only slightly larger than the females, and the color of the pelage in both is the same. Numerous as they are in certain districts of the Pacific Northwest, they are nevertheless slow breeders. This condition in nature is usually associated with comparative freedom from natural enemies, a plentiful food supply, or a considerable degree of hardiness, adaptability, or longevity. As far as natural enemies are concerned, it seems certain that such predacious birds and mammals as would take toll of mountain beavers were never abundant in the humid coastal belt of western Washington and Oregon. The coast Indians are said to have varied their salmon and huckleberry diet with mountain-beaver stew, though apparently they did not hunt the animals extensively.

In the Puget Sound country mating among mountain beavers takes place late in February and in March, when the sexes attain their seasonal development. By April 5 in two successive years the males were noted to have passed their sexual prime, as indicated by the reduced condition of the sex glands and by the degeneration of the firm, fatty tissue that surrounds them. They appear gaunt and thin then, too, as if hard run in the mating season, though there are no scars of combat on them. By the last of the month, however, they show considerable recuperation.

In the female, seasonal development of the uterus was not noted until late in February. Early stages of pregnancy were first observed on March 20. Two record series of April 5 gave a total of 11 cases of pregnancy in 26 females examined; of the others, 6, though apparently mature, had not mated, and 9 were immature yearlings. On April 25 the condition of 12 of 23 females showed that they had recently borne and were suckling young; 11 had not been pregnant, but most of those were yearlings. In 16 records of pregnancy or litters of young, there were 7 cases of twins and 9 of triplets. No other number of young was noted in any observation. The period of gestation can not be far from 30 days.

The task of finding a nest of the young mountain beavers proved difficult, as the burrows take their course apparently in an aimless fashion among logs, stumps, roots, and trees, where excavation is laborious and indications of probable nest locations uncertain. After parts of four days had been spent in digging in likely situations where females apparently suckling young had been trapped, a nest was located in a firm bank of earth and gravel associated with the upturned roots of a large fallen tree. (Fig. 11.) The nest cavity was somewhat oval in shape, about 20 inches in the horizontal diameter and 13 in the vertical. A burrow with several extensive ramifications beyond the tree roots ran under the trunk and connected with the nest chamber near the larger end. At the smaller end the chamber communicated with a basinlike excavation about 6 inches lower than the bottom of the nest.

Two tunnels led off from opposite sides of this basin, as if designed for drainage. In fact, one of these tunnels contained considerable water. Three blind excavations for food storage pocketed out from the walls of the nest chamber. One of these, of the capacity of about a peck, held 2 or 3 quarts of brake-fern roots cut into sections several inches in length. These had evidently been stored in the fall and were of little food value when found. In the other two pockets were some freshly stored leaves and stems of the common nettle (*Urtica lyalli*) and cuttings of evergreens—cedar and fir. The nest was constructed mainly of brake-fern leaves and stems, together with considerable dried grass and some fine dead twigs.

Three young mountain beavers apparently less than a week old were in the higher and drier part of the nest (fig. 12) and, when found, were covered by some of the nesting material. The heads were disproportionately large, and the eyes were not yet open. The bodies were not naked, as in some very young mammals, but were covered with a growth of fine, soft, light-brown hair. The combined weight of the three was 10 ounces. The interesting adaptation of the front feet to serve as hands for grasping, noted in the adult, is even more pronounced in the young. On the heel of the palms

are two elongated processes, which, with the thumb, oppose the four fingers and thus assist in grasping.

Observations on June 5 indicated that some of the females were still suckling their young. Three of the latter, trapped with their mother in the same burrow, averaged 8 ounces each in weight. At the time of the succeeding mating season the young of each year have attained approximately two-thirds to four-fifths the weight of the adults, the males having the lead in development. Though some of the yearlings may have become sexually mature at this season, most of them certainly have not. They can still be distinguished from the adults in June of their second summer by their slightly smaller size and plumper appearance and by the condition of the sex organs.

In poison investigations with mountain beavers very few of the dead animals have been found outside the burrows. They commonly

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FIGURE 11.—Nest of mountain beaver in its natural position. Enlargements of the burrows under old logs, in the hillocks formed by uprooted trees, in shelving banks, and about the bases of stumps are used as nesting sites

take the food within their retreats to eat it. Results of poisoning must therefore be looked for in the disappearance of the occupants, as shown by the neglect of check baits put out later and in the disuse of the burrows.

ECONOMIC VALUE

Whether from prejudice or from first-hand knowledge of its quality, the early settlers in the Northwest did not highly esteem the flesh of the mountain beaver, and while later generations have not cared to investigate its table merits, the resident Indians pronounce it good. It is dark in color and possesses a certain rankness of scent that does not commend it as a table delicacy, though this fault might be overcome by proper cooking.

Skins of mountain beavers were used by the Indians to some extent in making robes or blankets, but it appears that the Hudson's

Bay Co. never handled them. Later investigations have been made by the Bureau of Biological Survey, with the cooperation of furriers, to ascertain their value as peltry, but with negative results. The fur is found to be too flat for profitable use in the fur trade, because of insufficiency of underfur.

In spite of the apparent hardiness and adaptability of mountain beavers, the animals do not endure captivity well. When kept in roofed and floored inclosures they rarely live more than a week or two, even when given dry nesting material in boxes, fresh water, and plenty of food of the kinds they eat in the wild. In outdoor inclosures, securely fenced, they do well and, in certain climates, could probably be kept indefinitely in zoological parks. Attempts to

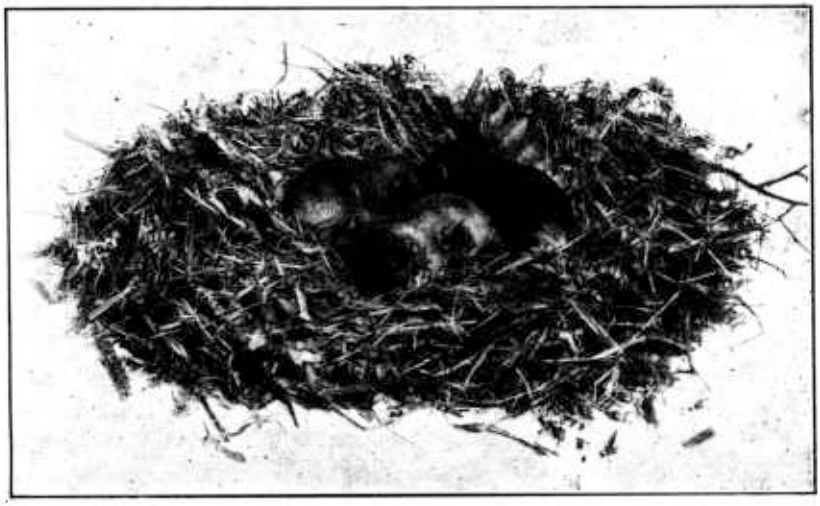

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FIGURE 12.—Young of mountain beavers. These little animals were photographed in the higher and drier part of the nest, which was constructed mainly of brake-fern leaves and stems, with a mixture of dried grasses and fine dead twigs

ship them alive across the continent, however, have thus far failed. This fact is to be regretted, for a little animal that is so unsuspecting and docile as to eat green food from one's hand almost immediately after being released from a bag or trap would interest many who can not visit its natural haunts.

METHODS OF CONTROL

A campaign of extermination directed against the mountain beaver would be wholly unnecessary and certainly without the practical results sought. The natural haunts of the animal are in the seclusion of the forest, where the genus Aplodontia is entrenched throughout a thousand miles of coast range and where it is not known materially to affect man's interests. Since the presence of the mountain beaver can not be tolerated in agricultural districts, however, measures must be taken there to keep it within bounds. This should not be difficult, for the animals rarely forage far from their burrows or establish themselves for long in the open. In some situations reforestation projects will require that control measures be directed against the species to safeguard the forest transplants.

TRAPPING

Fortunately, for control purposes, the mountain beaver is not particularly wary by nature nor suspicious of man through inbred experience. The animals may be easily caught by means of the ordinary steel trap or by the use of a box trap. Ranchers in the Northwest generally resort to the steel trap to keep their premises free from these rodents. The No. 1 trap is the right size for this animal, as the smaller No. 0, or rat-trap size, commonly used about the farm, is not strong enough to hold a full-grown mountain beaver.

The traps should be set in any used burrow or half-hidden path of the animal wherever one can be found—commonly along the forest borders of the field, about logs, stumps, and brush piles, in shelving banks, and in or near drainage ditches. When setting a trap in the burrow select an opening that is used for a passageway only and not as an alley for pushing out excavated earth, spoiled food stores, or other trash. If the trap is placed in the latter situation the animal is almost sure to bury it in rubbish. A good set may often be made through an opening in the roof of the burrow, for then the animal will be caught when passing in either direction. As the mountain beaver does not hestitate to climb over anything in its way, no attempt need be made to conceal or cover the trap. It is well to place the trap as nearly lengthwise of the burrow as possible, so that the free jaw is not folded over when the animal crowds against it. In the rainy season the more protected and drier parts of the runways will show greater use and therefore should be selected for trapping operations. The trap itself must, of course, be secured by stake and chain. Traps should be visited at least twice a day, morning and evening, so that any prisoners may be dispatched without unnecessary delay, and in order to keep all traps working to their fullest capacity.

When box traps are used the animals will be caught alive, though sometimes they perish apparently from fright. These traps should be about 9 or 10 inches high and wide and twice as long, and may be made of rough or unplaned boards. The top and the front end are nailed together, the top being hinged at the back by two nails driven through gimlet holes in the sides. This combined top-and-end door is raised and held in position when the trap is set by a cord passing over a post at the rear, or a steeplelike projection of the back end. This should be about as high as the trap is long. A trigger arrangement is shown in the accompanying illustration. (Fig. 13.) To prevent the prisoner's escape, a spring catch, such as that used for cupboard doors, or a similar device, is necessary to hold down the lid when the trap has been sprung. An iron netting or grating of some sort in the rear is necessary for ventilation and to engross the animal's attention; otherwise the captive may ruin the trap by gnawing at the cracks.

The best bait to use with box traps is apple—a piece on the trigger and a few bits of peeling trailed from the inside of the trap to the runway. The animals are readily attracted by the apple scent and will usually without hesitation enter the trap thus baited. When apples are not available carrots make a good substitute. In spring and summer it has been noted that the best catches with box traps are usually made during the hour preceding sunset. The inexperienced trapper need not be discouraged if his catch sometimes escapes;

for in a series of investigations with box traps it was noted that the same mountain beavers were recaptured several times after they had been purposely released. A number were caught three or four times; one died while undergoing its ninth imprisonment; and another succumbed in its tenth. Sometimes an individual would enter the trap twice in the same day and even return almost immediately after being released.

POISONING

In any attempt to poison mountain beavers it must be borne in mind that these animals usually have access to an abundant food supply at all times. Acceptable baits, therefore, must be particularly attractive by reason of odor or taste. In extensive trials with a number of baits it was discovered that apple gave the best results; fairly good results also attended the use of carrots and green clover tops. As high as 90 per cent kill has resulted from such baits treated with strychnine alkaloid.

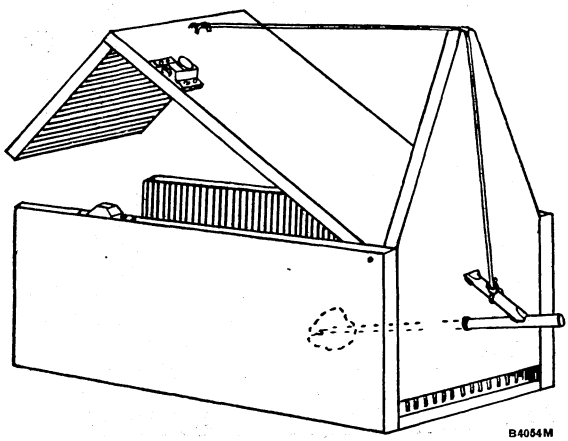

FIGURE 13.—A box trap for mountain beavers should be about 9 inches in height and width and twice that in length, and should be provided with a spring catch on the lid and a metal grating at the rear. The lid is held open by a string passed over an elevated support to the trigger, on the end of which is the bait

The strychnine alkaloid should be purchased in the powdered form and mixed with about one-eighth its bulk of powdered saccharine. It may then be kept in a salt shaker or other sifter-top container, properly labeled, and put in a safe place to be used as needed. It is well to carry the poison supplies to the field and prepare the baits where they are to be distributed. This insures their being fresh and obviates the danger of accidental poisoning about the farm premises. Cut the apple or carrot into small slices or thick peelings and dust the poison mixture sparingly over them in a pan. Clover tops should be dipped in water mixed with a very little sirup and then shaken well before they are dusted with the poison.

Distribute the poisoned bait, two or three pieces at a place, about or just within the clean openings into the burrows and in the half-hidden paths among the logs and stumps. The advantage in putting out the baits late in the afternoon or early in the evening is that they will be fresher when found and less likely to be appropriated by chipmunks or red squirrels. For the safety of these and other small forest animals, all baits not taken by the mountain beavers should be gathered up each morning. It is not safe to distribute poison for mountain beavers in situations to which poultry or other livestock have access, unless the baits are very carefully protected.

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